Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Period: \_\_\_\_

**Unit 8 Notes: Evolution**

Ms. Ottolini, Pre-AP Biology

**Part 1: The History of Life**

**I. How Did Life Come to Be? –Theories**

1. **Dark Ages:** “Life arose from \_\_\_\_\_\_\_\_\_ matter.” This process is known as \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

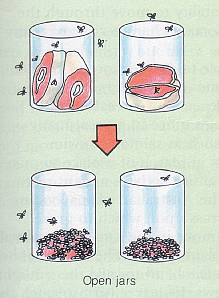
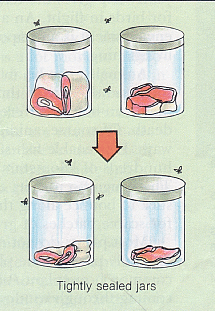
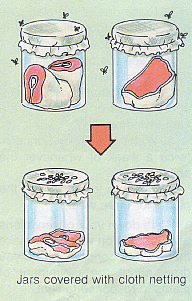
Ex: Rats from dirty clothes, frogs from mud, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

B. **Renaissance**

1. 1668: An Italian doctor named \_\_\_\_\_\_\_\_\_\_\_\_\_\_ proposed the theory of \_\_\_\_\_\_\_\_\_\_ 🡪 “life comes from life”

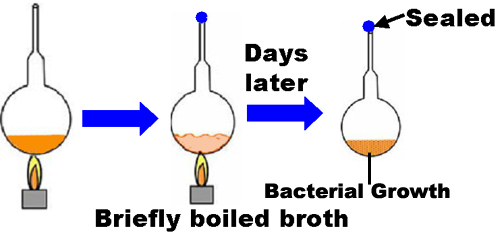
Redi’s Hypothesis: maggots come from \_\_\_\_\_, not rotting meat

**Control Group (Open) Exp. Group #1 (Lid) Exp. Group #2 (Screen)**



Result: \_\_\_\_\_\_\_\_\_\_\_\_\_ Result: \_\_\_\_\_\_\_\_\_\_\_\_\_ Result: \_\_\_\_\_\_\_\_\_\_\_\_\_

Redi’s conclusion: \_\_\_\_\_\_\_\_\_\_ (life comes from life) is correct!



1. 1745: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ tried to prove that spontaneous generation was correct

Steps to Experiment:

1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Needham felt this proved that \_\_\_\_\_\_\_\_\_\_\_(living) came from \_\_\_\_\_\_\_\_\_(non-living) after killing all existing bacteria in the broth. What was wrong with his experiment?

3) 1770: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_was an Italian priest who believed Needham did not boil the broth \_\_\_\_\_\_\_\_\_\_\_ to kill all existing bacteria. How were his results different?

4) 1862: \_\_\_\_\_\_\_\_\_\_\_\_\_\_ did another experiment with broth, which led to the concept of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. (See image on the next page). Which theory (biogenesis or spontaneous generation) was supported by his results?

|  |  |  |
| --- | --- | --- |
| **Treatment** | **Description** | **Picture** |
| Control | Boiled broth in an\_\_\_\_\_\_neck flask…a year later found \_\_\_\_\_\_\_\_\_\_ in flask | **Open Flask** |
| Experimental | boiled broth in a \_\_\_\_\_\_\_\_\_neck flask (swan neck keeps bacteria from \_\_\_\_\_\_\_\_\_)… a year later found NO \_\_\_\_\_\_\_\_\_\_\_ | **Swan-Neck Flask** |

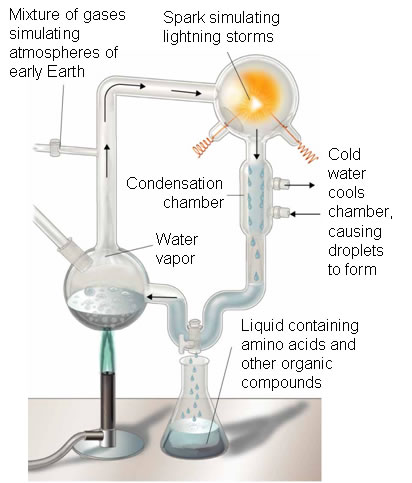
**II. Earth Before Life**

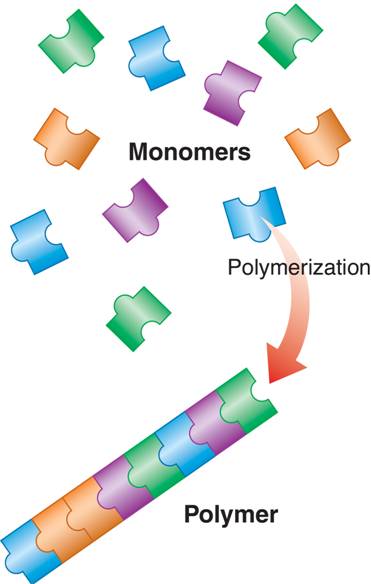
1. **Formation of the Earth**

-\_\_\_\_\_\_\_ billion years ago

-Early Atmosphere: \_\_\_\_\_\_\_\_\_, \_\_\_\_\_\_\_\_\_, \_\_\_\_\_\_\_\_\_\_, \_\_\_\_\_\_\_\_\_, \_\_\_\_\_\_\_\_\_\_, and \_\_\_\_\_\_\_\_\_\_\_\_

1. **Synthesis of Organic Molecules**
2. 1924: Alexander \_\_\_\_\_\_\_\_\_ hypothesized that conditions in early \_\_\_\_\_\_\_\_\_\_\_\_\_\_caused compound to form \_\_\_\_\_\_\_\_\_\_\_ (carbon-containing) molecules (ex: \_\_\_\_\_\_\_\_\_\_\_\_)
3. 1953: Stanley \_\_\_\_\_\_\_\_\_ and Harold Urey set up an experiment to show that the following reaction took place





1. **Polymerization:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

small organic molecules to make \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

|  |  |  |
| --- | --- | --- |
| **Building Blocks** |  | **Macromolecules** |
|  |  |
|  |  |
|  |  |
|  |  |

1. **First \_\_\_\_\_\_\_\_\_\_\_\_\_ and “protocells” (early cells) called \_\_\_\_\_\_\_\_\_\_\_\_\_**Membrane made out of phospholipids. Draw a

microsphere with phospholipids in the box to the

right.

1. **Heredity and Replication**

\_\_\_\_\_ was the first \_\_\_\_\_\_\_\_ acid to be used as

genetic material because it could “\_\_\_\_\_\_\_\_\_\_\_”

(make a copy of itself)

Why would RNA need to be able to self-replicate?

**III. Early Life**

1. The first organisms were \_\_\_\_\_\_\_\_\_\_\_\_\_ (single celled). They were \_\_\_\_\_\_\_\_\_\_\_\_\_\_ (consumed other organisms for food) and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (had no nucleus or membrane-enclosed organelles)
2. Blue green algae and certain types of bacteria were the first organisms to be able to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (create glucose from the energy in sunlight and carbon dioxide). They release \_\_\_\_\_\_\_\_\_\_\_\_ into the atmosphere and allowed for \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ organisms to evolve.
3. The first aerobic organisms evolved. These organisms used \_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to convert glucose into ATP.
4. The first eukaryotic cells arose through the process of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. Draw and describe this process in the space below:
5. Multicellular organisms evolved with \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ cells to perform particular functions for the organism.

**Part 2: Evolutionary Theories**

There are several scientists who observed and predicted the causes behind \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

***Evolution* =** change in a \_\_\_\_\_\_\_\_\_\_\_\_\_ of organisms over a period of time. A population is a group of members of a single \_\_\_\_\_\_\_ living in a particular area

A. **Jean Baptiste Lamarck**

***Theory of***\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_: body parts that get used become larger and stronger; unused parts become smaller

***Theory of Inheritance of*\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_:** modifications acquired during the life of an organism could be passed to offspring

***Summary of Theories***

1) Organisms constantly try to \_\_\_\_\_\_\_\_\_\_\_

2) This effort causes changes in body parts

3) Once a structure is modified, it is passed on to future \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Example: \_\_\_\_\_\_\_\_\_ neck hypothesis 🡪 giraffe necks are long because \_\_\_\_\_\_\_\_\_\_\_\_giraffes had to stretch to reach their food

B. **Charles Darwin**

Geologist and \_\_\_\_\_\_\_\_\_\_\_\_. Sailed to South America and the Galapagos Islands on the H.M.S. \_\_\_\_\_\_\_\_\_\_\_. Recorded observations of exotic plants and animals for the Queen. Studied \_\_\_\_\_\_\_\_\_\_\_ and their beaks. Concluded that beak shape is related to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

***Darwin’s Theory of Natural Selection***

1. There is \_\_\_\_\_\_\_\_\_\_\_\_\_\_ in every population
2. Some variations are \_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. More young are produced in each generation than can \_\_\_\_\_\_\_\_\_\_\_\_
4. There is \_\_\_\_\_\_\_\_\_\_\_\_\_\_ for resources
5. Those that are successful go on to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
6. Overtime, small changes accumulate in a population because the \_\_\_\_\_\_ \_\_\_\_\_\_\_\_continue to be passed on

***Is this survival of the fittest?***

No! To be fit means more than just to survive…you have to be able to \_\_\_\_\_\_\_\_

***Fitness*** = a single organism’s \_\_\_\_\_\_\_\_\_\_\_contribution to the next generation Over time, a population \_\_\_\_\_\_\_\_\_\_\_\_as the number of favorable traits \_\_\_\_\_\_\_

***How do we get variation in a population?***

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_in the DNA create different gene forms. Natural selection “chooses” individuals with favorable mutations to \_\_\_\_\_\_\_\_.

Individuals can’t evolve but populations can. Why is this?

***Examples of Natural Selection***

**Peppered Moths:** There are two forms of peppered moth, light and dark. Before the Industrial Revolution, light moths survived and reproduced more effectively. After the Industrial Revolution, dark moths survived and reproduced more effectively. Why was this the case?

**Darwin’s Finches:** Darwin noticed that different species of finches on different Galapagos Islands had differently shaped beaks. There were also different types of seeds found on each island. Why do the different species have different beak shapes?

**Part 3: Evidence for Evolution**

1. **Fossils =**  traces of a long-dead organism, found in layers of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_sedimentary rock; hard \_\_\_\_\_\_\_\_\_\_\_\_\_ replace tissues of organism

***Types of Fossils***

1) \_\_\_\_\_\_\_\_\_\_\_ = imprint in rock

2) \_\_\_\_\_\_\_\_\_\_\_ = a mold filled with hard minerals

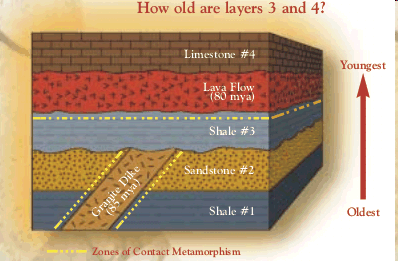
3) \_\_\_\_\_\_\_\_\_\_\_ = signs of life (footprints, burrowing)

4) \_\_\_\_\_\_\_\_\_\_\_= organisms that have been preserved nearly perfectly in plant resin (amber)

5) \_\_\_\_\_\_\_\_\_\_ = any living species that is nearly identical to species previously known only from fossils

***How do we determine the age of fossils?***

1) \_\_\_\_\_\_\_\_\_\_\_\_\_ age – the approximate age based on the position in \_\_\_\_\_\_\_\_\_\_\_ of sedimentary rock

2) \_\_\_\_\_\_\_\_\_\_\_\_\_ age – the exact age of a fossil based on \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ dating (ex: Carbon – 14)

***Relative Age – Rock Layers:*** Which is older, a fossil found in layer 2 or 4? How do you know?

***Absolute Age – Radioactive Dating***

1) when “isotopes” of atoms in fossils \_\_\_\_\_\_\_\_ into other “isotopes”

2) Remember: isotopes are the same atom with different numbers of \_\_\_\_\_\_\_

3) \_\_\_\_\_\_\_ = how long it takes for one-half of a sample of an isotope to decay

Ex: Carbon Dating (C14 🡪 C12)

1. **Comparative Anatomy** compare structures found in modern organisms to determine whether they are closely or distantly related.
2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Structures: inherited from a common \_\_\_\_\_\_\_\_\_\_\_\_, changed due to different \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Ex: Limb bones of whale, bat, human, etc.

1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Structures: similar in \_\_\_\_\_\_\_\_\_\_\_\_\_, but not inherited from a common \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Ex: Wings of insects vs. bird

C. **Vestigial Structures:** Features/structures that were useful to an ancestor but are no longer useful

Ex: \_\_\_\_\_\_\_\_\_\_ pelvis, human \_\_\_\_\_\_\_\_\_\_\_ + \_\_\_\_\_\_\_\_\_\_\_\_

D. **Comparative Embryology:** Finding similarities in \_\_\_\_\_\_\_\_\_\_ ; organisms sharing a recent ancestor have more similar embryos (discovered by Ernst \_\_\_\_\_\_\_\_\_\_\_\_)

E. **Comparative Biochemistry:** Finding similarities in \_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_ sequences to look for relatedness**.** On the next page is a DNA sequence in several different organisms…which two organisms are the most related? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

|  |  |
| --- | --- |
| Human | CCA   TAG   CAC   CTA |
| Pig | CCA   TGG   AAA   CGA |
| Chimpanzee | CCA   TAA   CAC   CTA |
| Cricket | CCT   AAA   GGG   ACG |

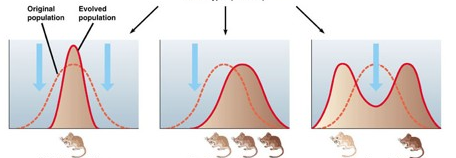
**Part 4: Types of Natural Selection**

A. **Stabilizing Selection** = individuals with the \_\_\_\_\_\_\_\_\_\_\_\_\_ form of a trait have the highest fitness

B. **Directional Selection** = one \_\_\_\_\_\_\_\_\_\_\_\_\_\_ form of trait is more successful

C. **Disruptive Selection** = \_\_\_\_\_\_\_\_\_ extreme forms are more successful than the average

The graphs below show the three types of natural selection given on the previous page. The dotted line in each graph represents the color distribution of the original mouse population. Label each type of selection.



\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

D. **Sexual Selection:** Females choose mates based on certain traits

Males with these traits have higher \_\_\_\_\_\_\_\_\_\_\_\_\_\_ (reproductive success)

E.  **Artificial Selection**: humans “select” certain \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in plants, dogs, etc., that they find \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Note: These organisms may not necessarily survive and reproduce better in nature

**Part 5: The Creation of New Species Through Evolution**

A. **Morphological Species Concept:** internal and external \_\_\_\_\_\_\_\_\_\_\_\_\_\_ are used to group organisms into species

B. **Biological Species Concept**– defines a species as a population of organisms that can successfully \_\_\_\_\_\_\_\_\_\_\_\_\_

C. **Speciation:** formation of a new \_\_\_\_\_\_\_\_\_\_\_\_

D. **Reasons for Speciation:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_ or \_\_\_\_\_\_\_\_\_\_\_\_\_\_ isolation.

E. **Rates of Speciation**

**Model #1:** **Gradualism** (change happens \_\_\_\_\_\_\_\_\_\_\_\_, and new species are made at a \_\_\_\_\_\_\_\_\_\_\_\_\_rate)

**Model #2:** **Punctuated Equilibrium** (there are times of \_\_\_\_\_\_\_\_\_ or no change followed by times of \_\_\_\_\_\_\_\_ change – often due to major changes in the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_) …. This model was designed by Stephen \_\_\_\_\_\_\_\_\_\_

Draw pictures of gradualism and punctuated equilibrium using the GRAPH METHOD and the TREE METHOD

**Graph Method Tree Method**

**Part 6: Patterns of Evolution**

A. **Coevolution:** change of two or more species in \_\_\_\_\_\_\_\_\_\_\_\_ to one another

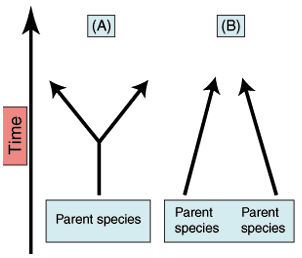
Provide TWO examples of coevolution:

1) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

B. **Convergent Evolution:** organisms with \_\_\_\_\_\_\_\_\_\_\_\_\_\_ ancestors become very similar due to \_\_\_\_\_\_\_\_\_\_\_\_ (Ex: sharks and dolphins)

C. **Divergent Evolution:** two or more \_\_\_\_\_\_\_\_\_\_\_populations/species become \_\_\_\_\_\_\_\_\_\_\_\_\_\_ (Ex: Darwin’s finches)



Label each graph to the right as CONVERGENT or DIVERGENT evolution.

D. **Adaptive Radiation:** an extreme form of \_\_\_\_\_\_\_\_\_\_\_\_\_evolution where \_\_\_\_\_\_\_\_\_ related species evolve from a \_\_\_\_\_\_\_\_\_\_ ancestor species